# EFFECT OF PROTECTED SODIUM BUTYRATE AND NUTRIENT CONCENTRATION ON PROTEIN AND ENERGY UTILIZATION IN BROILERS

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## ABSTRACT

The study was conducted to evaluate the effect of sodium butyrate protected with PFAD sodium salt (GUSTOR N'RGY) added to three different nutrient concentration diets on protein and energy utilization in broilers. A 2 x 3 factorial design was used with a basal diet based on wheat, barley and soybean meal with three different nutrient concentrations (control, CON, 3,000 kcal AMEn/kg, 22.02% CP and 11.6 g/kg dig Lys, CON-1 reduction of 60 kcal AMEn/kg and 2.3% of amino acids, AA, CON-2 reduction of 120 kcal AMEn/kg and 4.6% of AA) without or with additive (GUSTOR N'RGY at 1kg/t). A total of 162 male Cobb broiler chickens, were used in the digestibility study. Three birds per cage were placed in digestibility cages at 14 d of age. Each experimental diet was ad-libitum supplied to 9 cages/treatment and daily intake controlled. Total excreta was daily collected and weighed per cage on days 19, 20 and 21, frozen and oven dried. Crude protein retention and gross energy metabolizability (CPr and GEm) were calculated. Data were analyzed by two-way ANOVA using the GLM procedure of SAS. The reduction in nutrients concentration did not produce statistical differences in CPr (P = 0.164) nor in GEm. The inclusion of Gustor N'RGY did not affect CPr (58.87% vs 59.74%, P = 0.617) but improved GEm (69.94% vs 72.55%, P = 0.022). There were no significant interaction between nutrient concentration and feed additive inclusion. It can be concluded that the use of GUSTOR N'RGY is able to improve energy utilization in chickens in diets with different nutrient concentration.

**Keywords**: *Sodium butyrate; Digestibility balance; Broiler*

## INTRODUCTION AND OBJECTIVE

The benefits of using protected sodium butyrate on animal health and performance have been widely described in the literature. The protection with fats allows the butyrate to be released along the gastrointestinal tract (GIT) reaching the last parts of birds' GIT and improving the intestinal health through various mechanisms (MOQUET et al., 2016).

It is involved in the positive effects on the intestinal epithelium, such as supplying energy to the colonocytes and enterocytes, and enhancing the intestinal cells proliferation, differentiation and maturation (GUILLOTEAU et al., 2010); and also modulates the growth of symbiotic intestinal microflora (VAN IMMERSEEL et al., 2004 and 2005). It improves body weight, feed conversion ratio (FCR), beneficial bacterial populations, and reduces the colonization of harmful bacteria in the digestive tract of broilers (CHAMBA et al., 2014). In addition, sodium butyrate supplementation has been linked to improving immunity in broilers (ZHANG et al., 2011; ZHOU et al., 2014) and is reported to be essential for the correct development of the gut associated lymphoid tissue (GALT) (FRIEDMAN and BAR-SHIRA, 2005).

However, scarce literature has been focused on the effect on nutrients digestibility, for instance, MALLO et al. (2011) showed a significant digestibility improvement of energy and protein in broilers adding sodium butyrate. The present study was conducted to evaluate the effect of GUSTOR N'RGY (70% of sodium butyrate protected with sodium salt of palm fatty acid distillates) and three different nutrient concentration diets on protein and energy utilization in broilers.

## MATERIAL AND METHODS

Three hundred and seventy eight (378) 1-days-old Cobb males broilers chickens started the study on study day 0 (63 broilers per treatment group). There were three consecutive all in-all out batches. Birds were housed in pens of seven animals such that there were nine replicates per treatment group and three replicates per treatment group and batch.

Treatment groups were balanced by initial weight (Day 0). Birds were weighed again and individually identified using numbered wing locks at study day 7. Birds were weighed individually again weekly (study days 7, 14, 21, 28, 35 and 42). Feed intake per pen was measured weekly (study days 0-7, 8-14, 15-21, 22-28, 29-35 and 36-42) throughout the study (Data not show).

**Digestibility study:** At study day 14, three birds per pen were transferred to digestibility cages (a total of 162 birds in 54 crates in the overall study, one per pen; 9 cages per treatment). Selection of birds was done based on their weights in order to have a representative sample from every pen.

Digestibility phase lasted seven days, from 14 to 21 d of age. First four days (14 to 18) were an adaptation period. Total excreta was daily collected and weighed per cage on days 19, 20 and 21, frozen and oven dried at 103º C until constant weight. Feed intake was measured per crate during the adaptation and collection period (study days 14 to 21). Crude protein retention and gross energy metabolizability (CPr and GEm) were determined.

Birds were fed treatment diets from 0 to 21 d of age (Table 1). Treatments consisted of a control diet, formulated with standard European ingredients, CON, CON-1 (CON with a first reduction of 60 kcal AMEn/kg and 2.3% of amino acids, AA), CON-2 (CON with a second reduction of 120 kcal AMEn/kg and 4.6% of AA), N'RGY (CON diet with GUSTOR N'RGY at 1kg/t), N'RGY-1 (CON-1 diet with 1 kg of N'RGY/t) and N'RGY-2 (CON-2 diet with 1 kg of N'RGY/t).

**Table 1.** Ingredients and chemical composition of experimental diets.

| | **CON** | **CON-1** | **CON-2** |
|---|---|---|---|
| *Ingredients, %* | | | |
| Wheat | 49.16 | 49.17 | 47.84 |
| Soyabean meal 47% | 36.45 | 35.02 | 34.81 |
| Soyabean oil | 5.71 | 4.69 | 3.78 |
| Barley | 5.00 | 7.50 | 10.00 |
| Dicalcium phosphate | 1.70 | 1.69 | 1.68 |
| Calcium carbonate | 0.77 | 0.78 | 0.78 |
| Sodium chloride | 0.40 | 0.40 | 0.40 |
| Premix[a] | 0.30 | 0.30 | 0.30 |
| DL-methionine | 0.26 | 0.24 | 0.23 |
| L-lysine HCL | 0.15 | 0.11 | 0.09 |
| Maxiban G 160[b] | 0.05 | 0.05 | 0.05 |
| L-threonine | 0.04 | 0.03 | 0.01 |
| Choline chloride | 0.03 | 0.03 | 0.03 |
| *Calculated composition, % DM* | | | |
| Crude Protein | 22.09 | 22.06 | 22.02 |
| Ether Extract | 7.34 | 6.34 | 5.46 |

| Crude Fiber | 3.00 | 3.02 | 3.06 |
|---|---|---|---|
| AMEn (kcal/kg) | 3010 | 2950 | 2890 |
| Dig. Lysine | 11.64 | 11.34 | 11.10 |

[a]Nutritional additives (per kg): Vitamin A, 1350000 IU (as Vit A acetate); Vitamin D3, 200000 IU; Vitamin E (α-tocopherol acetate), 5050 IU; Vitamin K3 (menadion sodium bisulphite), 4.85 g; Vitamin B2 (riboflavin sodium phosphate 2 aq), 4.75 g; Vitamin B3 (nicotinamide), 16.5 g; Vitamin B6 (pyroxidine HCl), 2.75 g; Vitamin B12 (cyanocobalamine), 11.75 mg; Vitamin C, 25 g; Vitamin H (Biotin), 10.25 mg; Lysine HCl, 15 g; DL-methionine, 12 g. Trace-elements (per kg): Iron as Iron sulphate 1aq., 1.73 g; Copper as copper sulphate, 3.37 g; Manganese as manganese sulphate 1aq., 4.22 g; Magnesium as magnesium sulphate 7aq., 1.26 g; Zinc as zinc sulphate 1aq., 4.83 g
[b]Narasin, 80g/kg and nicarbacine, 80g/kg

**Statistical analysis:** Data were analyzed by two-way ANOVA using the GLM procedure of SAS (SAS, 9.4). Significance was declared when probability P< 0.05, a near significant trend when 0.05 < P < 0.12.

## RESULTS AND DISCUSSION

The effect of GUSTOR N´RGY addition and different nutrient concentration on the digestibility balance of diets supplied to chickens of 20 d of age are presented in Table 2.

**Table 2.** Results of crude protein retention (CPr) and gross energy metabolizability (GEm)

| | Nutrients | Additive | CPr (%) | GEm (%) |
|---|---|---|---|---|
| CON | Standard | No | 61.38 | 70.79 |
| CON -1 | Reduction 1 | No | 59.31 | 69.59 |
| CON -2 | Reduction 2 | No | 55.93 | 69.43 |
| N’RGY | Standard | GUSTOR N’RGY | 58.08 | 72.98 |
| N’RGY -1 | Reduction 1 | GUSTOR N’RGY | 62.90 | 73.51 |
| N’RGY -2 | Reduction 2 | GUSTOR N’RGY | 58.23 | 71.17 |
| *Nutrients* | Standard | | 59.73 | 71.89 |
| | Reduction 1 | | 61.11 | 71.55 |
| | Reduction 2 | | 57.08 | 70.30 |
| *Additive* | | No | 58.87 | 69.94 [b] |
| | | GUSTOR N’RGY | 59.74 | 72.55 [a] |
| *SEM* | | | 5.122 | 3.238 |
| *P-values* | | | | |
| Nutrients | | | 0.1644 | 0.4596 |
| Additive | | | 0.6172 | **0.0216** |
| Nutrients * Additive | | | 0.2310 | 0.6865 |

The reduction of AMEn and total AA concentration did not produce any statistical differences in CPr nor in GEm. The inclusion of GUSTOR N’RGY did not affect CPr that was 59.3% as average (P = 0.617) but improved GEm in a 3.7% (P = 0.022). The present results are partially agreed with those found by MALLO et al. (2011), who found a significant digestibility improvement of energy (5.8%) and protein (4.7%) in broilers adding sodium butyrate at 1kg/t of feed. On the other hand, although there were no significant interactions between nutrient concentration and additive inclusion, animals fed reduced diet concentration plus GUSTOR N’RGY achieved similar results than those animals in standard diet without such additive, especially in GEm.

These results could be explained because butyric acid could be more available to chicks due to salts of palm fatty acid being hydrolyzed by acids in the gastrointestinal tract, improving gastrointestinal heath status and epithelial morphology. Offering a better development of the intestinal epithelium with an increased intestinal surface that would be in contact with the feed bolus, ensuring a better digestion (PLUSKE et al., 1996). Furthermore, this improvement in nutrient utilization could explain the reduction in feed conversion ratio observed by PUYALTO et al. (2016) with the use of sodium butyrate at 1 kg/t in a similar trial.

## CONCLUSIONS

It can be concluded that the use of sodium butyrate protected with sodium salt of palm fatty acid distillates at 1kg/t is able to improve energy utilization in chickens in diets with reduced nutrient concentration, achieving similar results as standard diets.

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